# Further Updated 2015 Reference Case Tristan da Cunha rock lobster assessment

Susan Johnston and Doug Butterworth

MARAM

Department of Mathematics and Applied Mathematics

University of Cape Town

Rondebosch, 7701

## Summary

This paper provides a further updated assessment of the rock lobster resource at the island of Tristan da Cunha, following new data that have become available since February 2015.

## Introduction

The age-structured population model used for this assessment is described fully in Johnston and Butterworth (2013a). The previous assessment of this resource was conducted in Feb 2015 (Johnston and Butterworth 2015a). Note that stock-residuals are now estimated for the period 1992-2012[1]). The model is fit to the following data (the value in square parentheses indicates the number of seasons of new data since the Feb 2015 assessment update):

1) Standardised powerboat CPUE for Tristan (1994-2014) (Johnston *et al*., 2015).[**+1**]
2) Commercial Catch-at-length data (males and females separate) (1997-2014) (Johnston and Butterworth, 2015b). [**+2**]
3) Biomass survey index data for Leg1 (2006-2014) (Johnston, 2015).
4) Biomass survey catch-at-length data for Leg1 (2006-2014). (Johnston, 2015). [**+1**]

This updated assessment also assumes the TAC of 120 MT set for the 2015 season will be the 2015 catch.

The time periods over which the selectivity-at-length vector is assumed not to change in this assessment (and associated robustness tests) remain: 1990-2000, 2001-2005 and 2006+.

## Reference case model

As for previous assessments, the Reference case (RC) model fixes the natural mortality $M$=0.1 and the fishing proportion in 2009 to be $F(2009)$=0.3. It also assumes the stock residual variation parameter $\sigma_R$= 0.4. The catch-at-length data are down-weighted by a factor of 0.10 in the likelihood. Previously it was found that the model consistently overestimated the number of male lobsters in the larger size classes.

[1] Note that 2010 refers to the split season 2010/11 for example.

For this reason two further adjustments were made to improve the model fit (Johnston and Butterworth 2013b):

i) Increase *M* to 1.5 for lobsters aged 10+.
ii) Decrease selectivity on male lobsters by 25% for lobsters CL 110mm.

As previously, the RC model fits to Biomass survey data from Leg1 only. Leg1 is the survey conducted at the start of the season and is thought to be more reliable that the Leg2 survey which takes place at or near the end of the season.

The catch for the 2014/15 season is assumed to be 161 MT (the TAC set) and 120 MT for the 105/16 season.

Robustness tests are not updated in this document.

## Results

Table 1 reports the updated September 2015 Tristan RC assessment results. Results from the 2013 assessment and the February 2015 assessments are also reported where comparable values are available. Figures 1 and 2 report the RC model fits to the input data, as well as the RC model estimated biomass trends. The fits to the data remain are reasonable for the abundance indices (Figure 2a), but and the CAL data (Figure 2b). Figure 2c shows that there is reasonable consistency between the downward trends in abundance since 2006 which is indicated by the CPUE and survey data, though the latter is less marked over recent years.

The current status of the resource is estimated to be reasonably high with the 2015 spawning biomass 0.65 *K*, though status is marginally worse than estimated in the previous assessment; this status is lower at 0.39 *K* when expressed in terms of the exploitable component of the biomass (see Table 1). The population is estimated to have increased in size over the 1990-2006 period following the good recruitments in the late 1990's. The spawning biomass is estimated to have declined by about one third since 2006 as a result of poor recruitments during the early 2000's.

### References

Johnston, S.J. 2015. Final Tristan Group Biomass survey Leg1 results including data from the 2014 season. MARAM/Tristan/2015/MAY/04.

Johnston, S.J. and D.S. Butterworth. 2013a. The Age-structured Production Modelling approach for assessment of the Rock Lobster Resources at the Tristan da Cunha group of islands, MARAM/Tristan/2013/MAR/07.

Johnston, S.J. and D.S. Butterworth. 2015a. Updated 2015 Tristan da Cunha rock lobster assessment, MARAM/Tristan/2015/FEB/01.

Johnston, S.J. and D.S. Butterworth. 2015b. Updated observer catch-at-length data from the commercial fisheries at the Tristan da Cunha group of islands, MARAM/Tristan/2015/MAY/05.

Johnston, S.J., Brandao, A. and D.S. Butterworth. 2015. Updated 2015 GLMM- and GLM-standardised lobster CPUE from the Tristan da Cunha group of islands. MARAM/Tristan/2015/MAY/06.

Table 1: Updated 2015 Tristan RC assessment results. Results are also reported for the 2013 RC assessment estimates and the FEB 2015 assessments. Shaded values are fixed on input, and values in parentheses are $\sigma$ values.

| | **RC 2013** | **RC FEB 2015** | **RC SEP 2015** |
|---|---|---|---|
| # parameters | 41 | **42** | **43** |
| *K* (MT) | 1449 | **1366** | **1297** |
| *h* | 0.96 | **0.99** | **0.99** |
| *M* | 0.1 | 0.1 | 0.1 |
| *d* (discard mortality rate) | 0.1 | 0.1 | 0.1 |
| $\sigma_R$ | 0.4 | 0.4 | 0.4 |
| $F_{2009}$ fixed at | 0.3 | 0.3 | 0.3 |
| $\theta$ | 0.373 | **0.371** | **0.391** |
| -lnL total | -42.81 | **-43.32** | **-45.57** |
| -lnL commercial CPUE ($\sigma$) | -35.28 (0.09) | **-36.35 (0.09)** | **-37.14 (0.10)** |
| -lnL Bio Sur Index Leg1 ($\sigma$) | -8.69 (0.15) | **-8.80 (0.15)** | **-12.54 (0.13)** |
| -lnL commercial CAL ($\sigma$) | 6.23 (0.11) | **11.81 (0.11)** | **20.97 (0.11)** |
| -lnL Bio Surv Leg 1 CAL ($\sigma$) | -30.21 (0.08) | **-33.43 (0.08)** | **-31.16 (0.08)** |
| SR pen | 4.25 | **4.67** | **5.79** |
| Bsp(2013) (MT) | 1085 | **980** | **916** |
| Bsp(2014) (MT) | - | **980** | **863** |
| Bsp(2015) (MT) | - | **1008** | **842** |
| Bsp(1990)/Ksp | 0.35 | **0.34** | **0.34** |
| Bsp(2013)/Ksp | 0.75 | **0.72** | **0.71** |
| Bsp(2014)/Ksp | - | **0.72** | **0.67** |
| Bsp(2015)/Ksp | - | **0.74** | **0.65** |
| Bsp(2013)/Bsp(1990) | 2.17 | **2.09** | **1.95** |
| Bsp(2014)/Bsp(1990) | - | **2.09** | **1.84** |
| Bsp(2015)/Bsp(1990) | - | **2.18** | **1.80** |
| Bexp(2012)/Bexp(1990) | 2.06 | **1.97** | **1.87** |
| Bexp(2013)/Bexp(1990) | - | **1.88** | **1.63** |
| Bexp(2014)/Bexp(1990) | - | **1.92** | **1.48** |
| Bexp(2012) (MT) | 424 | **400** | **382** |
| Bexp(2013) (MT) | - | **383** | **333** |
| Bexp(2014) (MT) | - | **390** | **302** |
| Bexp(2014)/Kexp | - | **-** | **0.39** |
| Program | Tnewup.tpl; tup.rep | **T15.tpl, rc15.rep** | **T15up.tpl, r15up.rep** |

Figure 1a: Tristan RC updated SEP 2015 model results. Note also that the stock-recruitment residuals are now estimated up to 2012, with the 2013 value indicating the level that is assumed for future projections.

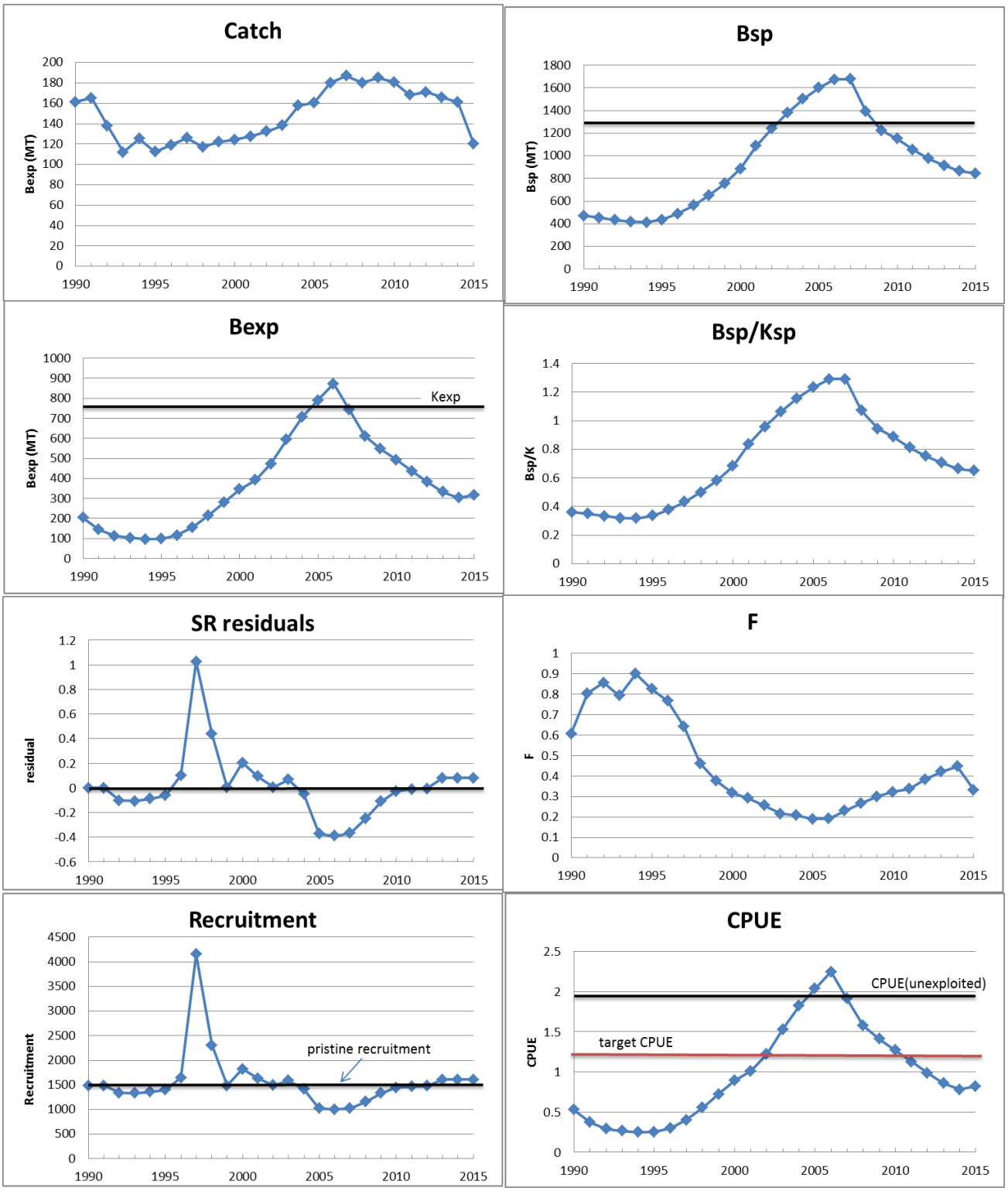

Figure 1b: Tristan RC selectivity functions.

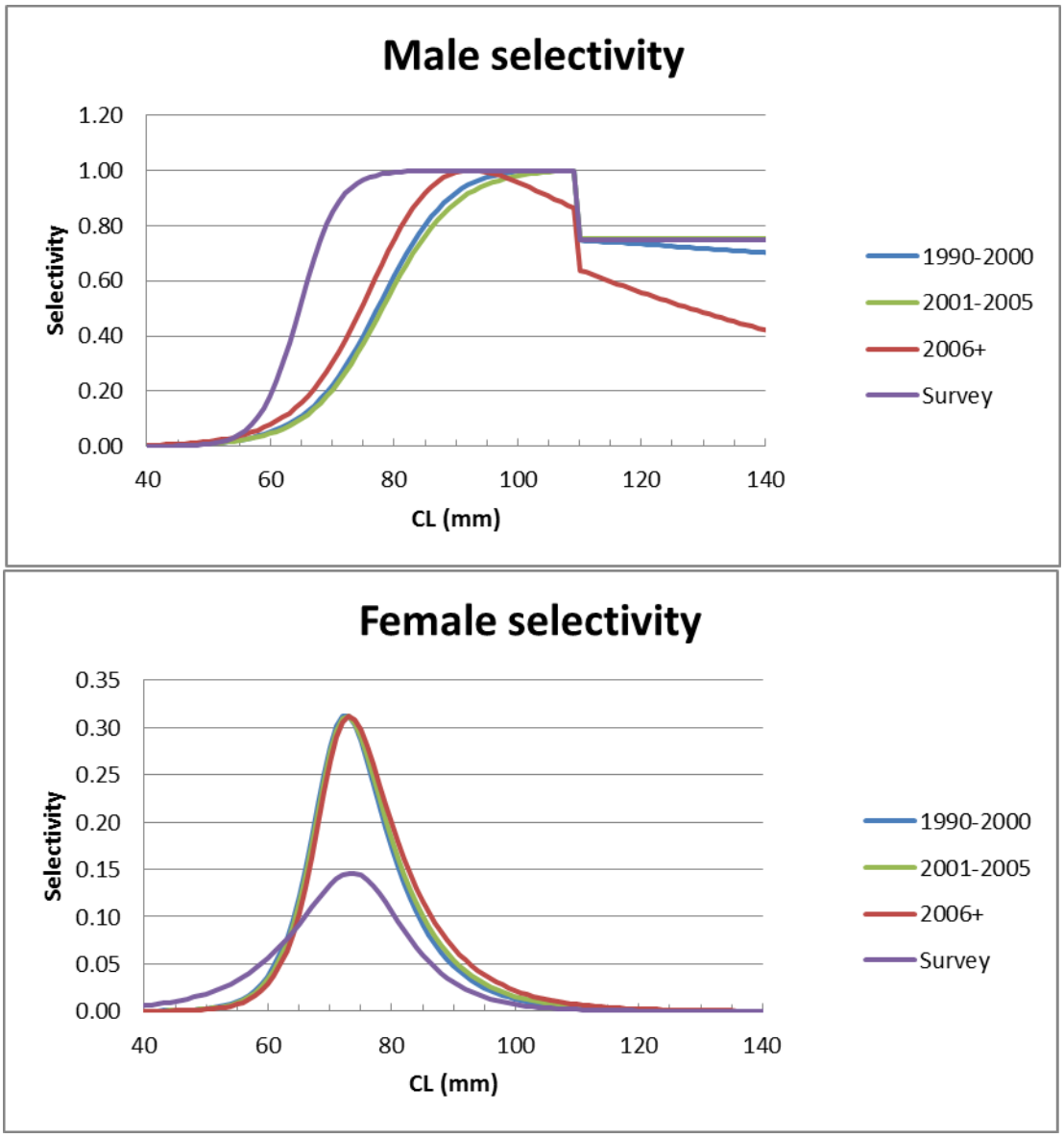

Figure 2a: Tristan RC model fits to CPUE and Biomass survey index data. The most recent (August 2015) biomass survey data value (which is not included in the model fitting procedure) is shown as an open circle in the bottom plot.

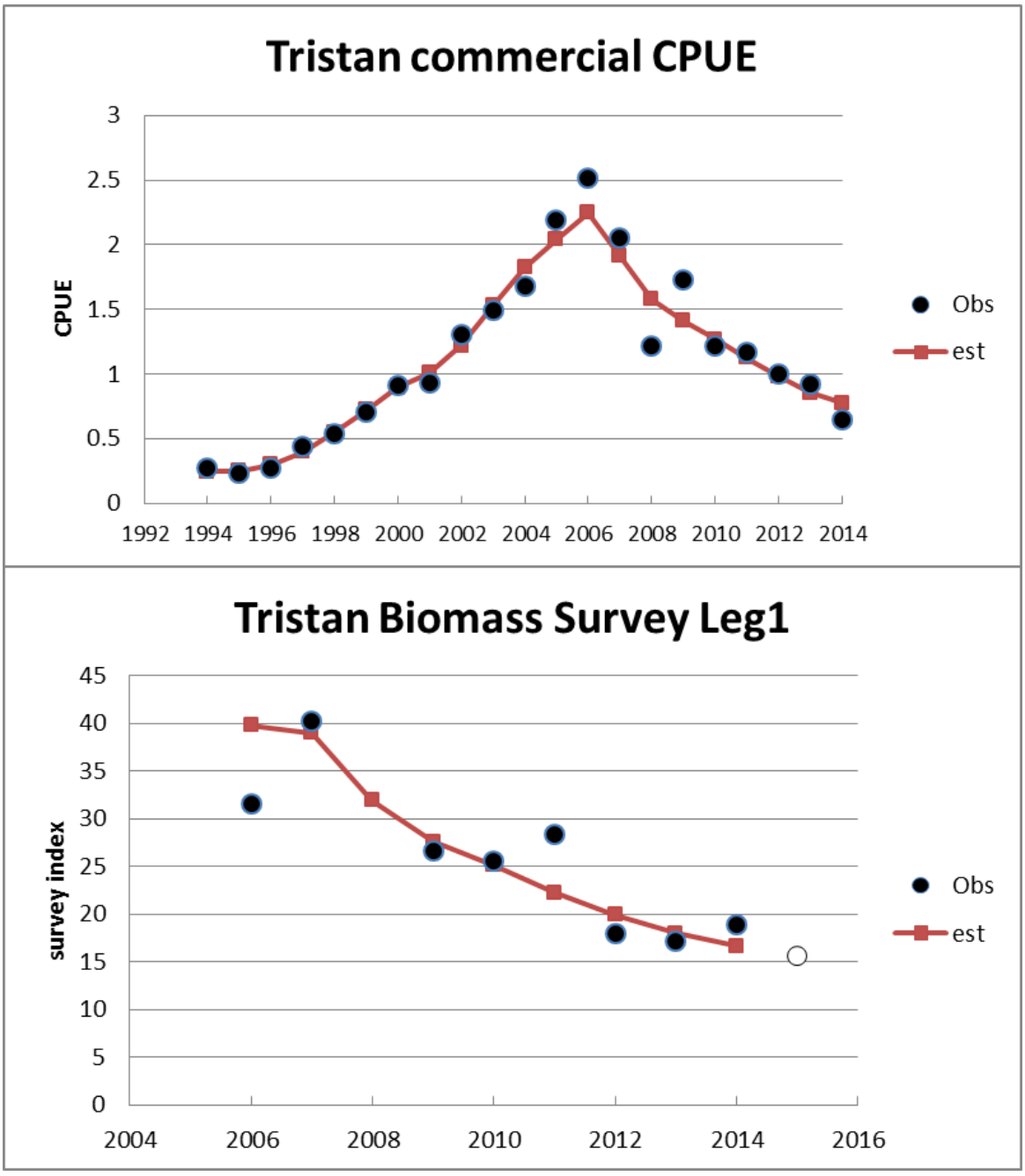

Figure 2b: Tristan average CAL results.

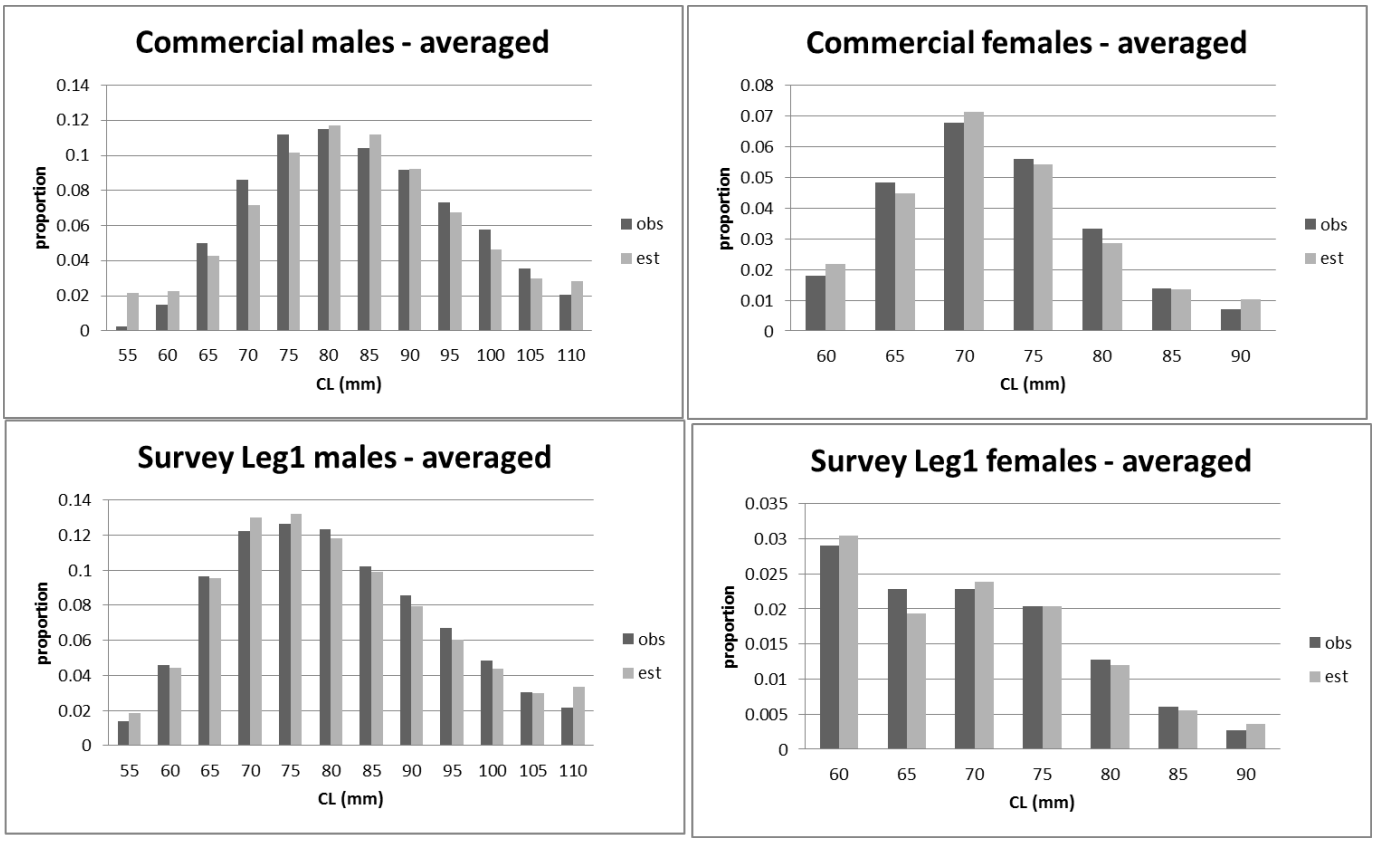

Figure 2c: Observed CPUE and biomass survey data (renormalized to the average CPUE value over 2009-2014) shown on same plot.